A Quantitative Analysis of Pragmatic Language in Adults with High-Functioning Autism

Honors Research Thesis

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by

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Abstract

Individuals with autism spectrum disorder (ASD) often have impaired social communication, particularly pragmatic language (DSM-V; APA, 2013). We aimed to identify differences in pragmatic language in conversations between typically developed (TD) individuals and high-functioning adults with autism (HFA). HFA (n = 8) and TD (n = 8) individuals participated in guided discussions that were recorded, transcribed, and specifically analyzed for off-topic responses, disrupted turn-taking events, use of discourse markers, and frequency of mental state references. We also examined the social connectedness of the individuals; half of the participants had previous experiences with one another, and half of the participants were strangers. The TD group was less often off-topic than the HFA group. While there was no difference in the type of disrupted turn-taking events, the groups differed in how these events functioned, with socially connected individuals disrupting more often in non-supportive ways. Social connectedness was also significant for turn winner, suggesting that speakers who disrupt win the turn more often in socially connected groups than they do in conversations between socially unconnected people. Discourse markers, words that maintain grounding and listener understanding, were analyzed, specifically for the use of *like* and *you know*. The TD group used *like* more than the HFA group, and there was no difference for *you know* between the groups. Lastly, the TD group used more mental state words than the HFA group. These results suggest that conversations between HFA individuals differ from TD individuals because of these subtle differences in pragmatic language usage. These patterns potentially have utility in developing diagnostic tests, especially in parsing strengths and weaknesses of individuals with HFA.

A Quantitative Analysis of Pragmatic Language in Adults with High-Functioning Autism

Individuals with autism spectrum disorder (ASD) have impaired social skills and communication, especially impacting their understanding and use of social language skills (DSM-V, American Psychiatric Association, 2013). An area particularly impacted is pragmatic language, which is a linguistic term referring to the social rules of everyday communication, including staying on topic and fluent turn-taking in conversation (Baron-Cohen, 1998). Successful use of pragmatics enables successful educational and occupational experiences, as well as friendships and social competence; thus, pragmatic language impairments are detrimental to the everyday lives of individuals with this disorder (Landa, 2000). With this study, we aimed to closely focus on pragmatic difficulties experienced by adults with high-functioning autism (HFA). Individuals with HFA possess IQ and verbal skills within the normal range, but they still have difficulties with pragmatic language (Baron-Cohen, 1998). This study quantitatively measured pragmatic language abilities as they occurred in natural discourse. The identification and measurement of these deficiencies may lead to additional research, diagnostic tools, and treatments to help individuals with HFA with their communication difficulties.

Social communication is a broad area of study, and many facets are impacted in individuals with HFA (Landa, 2000). Communicative intentions, presuppositions, and discourse organizations are three areas of social communication that are particularly impacted in individuals with ASD and have been well studied (Landa, 2000). Communicative intentions are social cues used as a means to an end, for example, using gestures early in development to express needs or wants. Presuppositions are the knowledge base shared between the speaker and listener in conversation, such as background details and awareness of social rules. Individuals with HFA are often impaired in this domain and use context-inappropriate styles such as

pedantic speech and failing to acknowledge the listener's topic (Baron-Cohen, 1998; Landa, 2000). These deficits in social communication result in impaired fluency and incoherence of speech.

Individuals with HFA have deficits in pragmatic language, including difficulty incorporating the listener's knowledge and staying on the listener's topic, using atypical intonation, and speaking pedantically (Baron-Cohen, 1998; Landa, 2000). These deficits result in unsuccessful communication, as these individuals struggle with conveying their thoughts successfully and understanding others in conversation. These social language impairments are often a hallmark of their condition and debilitating to their quality of life, as these difficulties impact friendships and create anxiety towards social interactions (Landa, 2000).

Many pragmatic language difficulties, as well as other cognitive impairments among individuals with HFA, are often attributed to deficits in theory of mind, which refers to understanding the perspectives of others (Baron-Cohen, 1998; Tager-Flusberg, 1998). Theory of mind is also linked to pragmatic language, as successful communication requires understanding what information others know and do not know. Thus, theory of mind consists of understanding others and pragmatic language is the communicative expression of that understanding (Tager-Flusberg, 1998). Many studies have shown that individuals with HFA have deficits in theory of mind tasks, especially in studies of narrative discourse, or story telling (Baron-Cohen, 1998; Beaumont & Newcombe, 2006). Referential pronouns, an area of pragmatics often studied in narrative discourse, are pronouns such as *he*, *she,* or *it* that are used to refer back to a previously described character or object. In one study, adults with ASD generated a story from a picture book, and the number of referential pronouns was analyzed (Colle, Baron-Cohen, Wheelwright, & van der Lely, 2008). Colle et al. found that individuals with ASD often used full noun phrases

instead of referential pronouns when referring to characters, making the narrative less coherent. Many studies have used these narrative paradigms (Losh & Capps, 2003; Loth, Gomes, & Happe, 2008), but very few have studied interactions among individuals with HFA and their abilities to use pragmatic language in conversation, especially in natural conversation.

There has been an emphasis in recent research on assessing naturalistic interactions and conversations to discover the nature of communication deficits. Naturalistic settings allow for examining the context of conversation, specifically integrating language usage with experience (de Villiers, 2005; Muskett, Perkins, Clegg, & Body, 2010). Because so little is known about the underlying causes of pragmatic language and social communication deficits in HFA, analyzing naturalistic conversation allows researchers to observe patterns in the phonological and semantic output (de Villiers, 2005). In a study of verbal exchange and eye gaze, Nadig, Lee, Singh, Bosshard, and Ozonoff (2010) used a naturalistic setting to study gaze-shifting and topic contingency in conversation in individuals with HFA. They found no difference between children with HFA and typical peers in social eye-gaze patterns in naturalistic settings whereas in non-naturalistic settings, researchers found that eye-gaze patterns do differ (Nadig et al., 2010). These studies highlight the importance of utilizing naturalistic settings when studying language and social communication, suggesting that the conversational context may play a role in the communicative abilities of individuals on the autism spectrum.

In addition to naturalistic settings, there has also been a recent emphasis in research on quantitatively analyzing pragmatic language. In one study, a group of researchers developed a scale of pragmatic language and used this scale to code 10-minute conversations of individuals with ASD and an experimenter (De Villiers, Fine, Ginsberg, Vaccarella, & Szatmari, 2007). These conversations were analyzed for five subscales of pragmatic language: atypical intonation,

minimal responsiveness, disengagement from the topic, perseveration on a particular topic, and pedantic speech. Atypical intonation was correlated with minimal responsiveness, and pedantic speech was correlated with perseveration. Although this study did not have a comparison control group, it is one of the first to quantify pragmatics in individuals with ASD.

Because of the extensive work showing that people with HFA have difficulties with pragmatic language, we focused especially on those abilities in the current study. What makes the current work distinctive, however, is the particular method utilized for analyzing pragmatic elements. We continued previous work exploring the conversational abilities of adults with HFA in a naturalistic setting, specifically by utilizing a discussion group setting where multiple individuals talk with one another and a facilitator about stories. This work is also unique in that it draws on the literature from the field of linguistics, which has a rich analysis for how language is used in conversations. Although linguistics literature is based on typical conversations, this background still provides a solid foundation for understanding the details of conversations and pragmatic language. To examine these details, we used quantitative analyses to examine the use of pragmatic language on a clause-by-clause basis. These methodological choices allowed for a very fine-grained assessment of the pragmatic abilities of adults with HFA and a detailed comparison to typically developed (TD) peers. In addition to basic language features, we specifically analyzed off-topic speech, disrupted turn-taking, and discourse markers. Although this study did not measure theory of mind directly, theory of mind was indirectly measured by counting total mental state references used by each participant. Because pragmatic language is associated with theory of mind, the mental state reference totals were correlated with pragmatic language measures.

Previous work has shown individuals with HFA have difficulties staying on topic and often digress (Baron-Cohen, 1998; Landa, 2000). Off-topic speech has also been related to the diagnosis of ASD. In one study, researchers explored the relationship between pragmatic language and diagnostic information, relating the level of contingent responding within a conversation to scores on the Autism Diagnostic Observation Schedule (ADOS) social and communicative sub-domains (Hale & Tager-Flusberg, 2005). ADOS scores were related to a natural language sample of a parent-child interaction. This sample was coded for whether or not utterances were noncontingent, contingent, or imitations. Results showed that noncontingent discourse was a predictor of ADOS scores in general, and also of the communication sub-domain, but not the social domain. Thus, the inability to stay on-topic is related to communication deficits in individuals with ASD.

Nadig et al. (2010) also analyzed conversational contingency between children with HFA and an experimenter. Overall, the children with HFA had a lower rate of staying on-topic than typical peers, especially when that topic was a circumscribed interest (i.e., vehicles) as opposed to a generic topic (i.e., the weather). In the current study, we aimed to replicate the findings of these studies, hypothesizing that individuals with HFA would have more off-topic responses than typical adults.

We also analyzed patterns of turn-taking in conversation, particularly patterns of disrupted turn-taking. Turn-taking is the interchange between conversational partners, in which only one person at a time speaks (Schegloff, 2000). Speakers collaborate using various transitions to produce fluent speech, such as pausing, completing their partner's statement, and directly asking a question to signal when they will relinquish the turn to the other speaker (Maroni, Gnisci, & Pontecorvo, 2008). However, when partners are not able to coordinate,

interruptions and competitions occur (Schegloff, 2000). In example 1, appropriate turn-taking occurs when Jane begins speaking after John completes his sentence, while in example 2, incorrect turn-taking results when Jane interrupts John midsentence, resulting in disrupted fluency in the conversation.

(1) John: I was hoping to go to the movies today.

Jane: I was hoping to go to the park.

(2) John: I was hoping to –

Jane: We should go to the park.

Disruptions in turn-taking often function differently in conversation. When disrupted turn-taking occurs, the speakers may compete for the turn, and thus it becomes a competition for the turn (Schegloff, 2000). There are also cases of disrupted turn-taking that are not of a competitive nature, for example, when a speaker interrupts to agree, saying "yes," or "mhm." In these cases, such disruptions are signaling that the listener understands the speaker, and the speaker has no intent to take the conversational floor. Thus, disrupted turn-taking takes many forms, some with more supportive, non-competitive intents, and some that are truly competitive for the turn. The functions of disrupted turn-taking, specifically supportive and non-supportive events were examined in this study. Since individuals with autism have difficulty with social interaction, we hypothesized that their disrupted turn-taking events would be more non-supportive, including more local topic shifting, than the typical group.

Disrupted turn-taking leads to disfluent conversations, and these events become a contest in which participants compete for who will win the floor and whose topic will be continued (Schegloff, 2000). These contests for the conversational floor can have several outcomes, some that resolve the disrupted turn and others that perpetuate it. Commonly, one speaker will drop out

very shortly after the event, resulting in the desired outcome of one speaker holding the floor. Often a speaker will cue other conversational partners when he or she is relinquishing the turn, for example by using eye gaze and body posture to signal to the listeners. However, when such cues are absent, speakers will compete for the conversational floor. They can use many devices to take the turn, including using louder volume, repeating themselves, or stretching out sounds. Schegloff also noted that the turn winner is not always the same as the topic winner. He stated that the initial speaker is more often allowed to have the topic than the person who steals the turn, however, there are situations in which the interrupter does steal the topic. For example, when someone interrupts to ask the speaker to clarify, his or her topic will be addressed. Schegloff described in great detail the stages of competing for the conversational floor, as well as described many hallmarks of these events; however, his work was qualitative, and broadly described disrupted turn-taking. The current work quantified disrupted turn-taking by examining which speaker won the turn and what topic was continued at the outcome of the disrupted turn-taking events. We predicted that the trajectory of the conversation after these disrupted turn-taking events would differ between the typical adults and the HFA adults.

Discourse markers are words or phrases such as *oh*, *well*, *like*, *you know*, and *I mean* that do not contribute to the literal meaning of sentences in conversation; rather, they aid in maintaining listener understanding and guide how the listener will interpret the sentence, thus building the conversational context between speakers (Fox Tree, 2010). Successful use of discourse markers achieves local coherence, appropriate turn-taking, sentence repair, and social solidarity, leading to a successful conversation (Fox Tree, 2010). Different discourse markers signal different information in sentences: in example 3, *um* is used as a pause and *you know* is

used to verify listener understanding; in example 4, *like* is used to indicate ambiguity or imprecision (Fox Tree, 2006).

(3) It was like the best vibes ever in the room, like everybody was *um* was, just in in love, *you know*?

(4) We had *like* this gnarly party.

While discourse markers have been studied in typical populations, few studies exist in which researchers analyzed discourse marker usage in individuals with ASD. Lake, Humphries, and Cardy (2011) studied the use of discourse markers in individuals with ASD, particularly examining the discourse markers *uh* and *um*, which are used to indicate a pause in conversation. They asked participants questions and examined the language samples for these discourse markers. They found that the ASD group produced significantly fewer discourse markers, and also had more disfluent repetitions and fewer revisions. Lake et al. suggest that instead of using *uh* and *um* in conversation, individuals with ASD used silent pauses, which were less clear in conveying their intended conversational trajectory, especially when repeating or revising their utterances. Although some *um* and *uh* pauses were used, they were used significantly less often, which may mean that these words are meant specifically for the listener's benefit.

While discourse markers in general add additional information for the listener's interpretation of the sentence, specific discourse markers add to this interpretation in different ways. The discourse marker *like* has many uses in adding to the context of the conversation. Fox Tree (2006) asserts that *like* is a "precise marker of imprecision" (p. 741) meaning that *like* is often used by speakers to indicate that their utterance is not to be interpreted literally. Jucker, Smith, and Ludge (2002) also cite *like* as a common strategy that speakers use to convey vagueness. Jucker et al. argue that vagueness allows speakers and listeners to have more efficient

conversations, using words such as *like* to approximate rather than give literal meanings to utterances. Fox Tree and Jucker et al.'s work supports the theory that *like* is not just a placeholder, it has a specific function to aid the listener in successful interpretation of the speaker's meaning. Thus the interpretation of speakers' meanings in conversations is heavily impacted by discourse markers, and specifically by the word *like*.

An additional discourse usage of *like* is the quotative use, or the phrase "be like" that introduces a quote as in example 5 taken from this study in which a participant reacts to reading *The Adventures of Sherlock Holmes*.

(5) TD6-Connected: I kinda like when he says **like,** "but how could you guess what the motive was?" And then he goes on saying where he's **like,** "I believe there was a woman in the house," like it's like on [page] two-twenty-three.

Fox and Robles (2010) examined a related quotative use, "it's like," stating that these quotative uses of *like* function to reenact thoughts and feeling and often convey emotional information. Ultimately, this quotative use builds a "shared world" between the speakers, in which these quotative uses of *like* allow the speakers to share and understand each others' emotions and feelings through these reenactments (Fox & Robles, 2010, p. 732). This builds on Jucker et al.'s (2002) interpretation of discourse *like*, as both studies show that discourse *like* is highly linked to the listener and the speaker developing an understanding and building a mutual interpretation. Because *like*, especially the quotative *like*, is thought to convey affect and create a shared experience, this discourse marker was specifically analyzed in this study. Because individuals with autism often have difficulties in understanding mental states, we hypothesized that deficits would emerge in discourse marker usage, *like* in particular, since this word is often used to build a shared world and aid successful interpretation between speakers.

Similarly, the discourse marker *you know* was specifically analyzed in this study. Fox Tree and Schrock found that *you know* is often used in conversation to be polite, as adding *you know* to an opinion is less threatening to other speakers, and thus facilitates more conversational interaction (2002). Fox Tree and Schrock also implicate *you know* as having a social component, as using this phrase may invite other speakers to respond. Because of this social function of *you know*, we hypothesized that individuals with HFA would use *you know* less frequently than typical individuals.

In this study we compared pragmatic language use in individuals with HFA to typically developed (TD) adults in the conversational context, looking at the use of off-topic responses, disrupted turn-taking, and discourse markers. A quantitative comparison allowed not only for a precise picture of pragmatic language in adults with HFA, but it also allowed for comparisons to be made with the typical group. The coding categories required an in-depth analysis of every line spoken by each participant. Thus, although the sample sizes for each group were small, a rich amount of data was collected and was sufficient to find meaningful differences.

We also examined the role of group context by varying the social connection between the participants. The relationship between conversational partners has influence on interaction, for example, friends are more relaxed, informal, and interrupt one another more than acquaintances (Panalp & Benson, 1992). Moreover, acquaintances are more polite, formal, and use more filled pauses in conversation. Because the relationship between conversational partners can impact many pragmatic elements in conversation, the social connectedness (i.e., socially connected, or socially unconnected) of the groups was also an independent factor in the analyses.

We predicted no differences between the groups for basic language abilities; we hypothesized that HFA and TD groups would have comparable language output and abilities. We

hypothesized that differences would emerge between the groups in measures of pragmatic language, especially in off-topic responses, disrupted turn-taking, and use of discourse markers.

First we predicted that the HFA group would be off-topic more than the TD group, replicating previous work, while the social connectedness of the groups would not affect the individuals' adherence to the topic. We also predicted that the socially connected group would have more disrupted turn-taking events than the unconnected group. However, we predicted that group (HFA, TD), not social connectedness, would affect the function of these events, with the HFA group using more non-supportive interruptions to locally shift the topic and turn than the TD group. We also predicted that the outcome of disrupted turn-taking events, namely the turn and the topic winner, would differ between the HFA and TD groups. Social connectedness was not predicted to affect the turn and topic winners. Lastly we predicted that the HFA group would have less discourse marker *like* and *you know* usage than the TD group, as discourse markers have a social role in maintaining listener understanding, and these two discourse markers in particular contribute to the social context of conversation. Social connectedness was not predicted to affect discourse marker usage.

An additional measure was number of mental state references, which was assessed as an indirect measure of theory of mind to link pragmatic language usage to mental state awareness. The HFA group was predicted to produce less mental state references than the TD group, and these mental state words were predicted to correlate with measures of pragmatic language, specifically that mental state word frequency would correlate positively with discourse marker usage and negatively with off-topic responses.

Methods

Participants

Two groups of four TD adults (n = 8) (M = 20.08, SD = 1.22) participated in the group discussions. One group was recruited from Ohio State University, and they received class credit for introductory psychology. The experimenter recruited the other group and they were paid for their participation. All TD adults did not self identify as having autism spectrum disorder.

Two groups of four HFA adults (n = 8) (M = 27.01, SD = 5.31) participated in the group discussions. Both groups were recruited through a support group specifically designed for adults with ASD, geared towards developing vocational and social skills (Hillier, Fish, Cloppert, & Beversdorf, 2007). All participants self identified as having HFA. Table 1 shows the group demographics.

Table 1
Subject Characteristics

Group	Participants (N=16)	Average Age (SD)	AQ Score Average (SD)	Session Length (minutes)
HFA				
Connected	4	22.72 (3.01)	--	54.43
Unconnected	4	31.30 (2.80)	25.75	59.95
TD				
Connected	4	20.04 (0.47)	20.00	60.27
Unconnected	4	20.11 (1.82)	--	29.08

Notes: Connected HFA and Unconnected TD groups did not complete the AQ; it was added to the IRB protocol for the Unconnected HFA and Connected TD groups. AQ = Autism Spectrum Quotient.

The groups were counterbalanced for the social connectedness among the group members. Two of the groups were comprised of individuals who had a social connection with one another,

as they were acquaintances through prior experiences. The other two groups were comprised of individuals that had no previous experiences with one another, and thus had no social connection.

The unconnected HFA group and the connected TD group were also given the Autism-Spectrum Quotient (AQ) (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) [1]. The AQ is a screening tool, and is not a diagnostic tool for clinically confirming an ASD diagnosis (Baron-Cohen et al., 2001). Scores on this test over 32 suggest that an individual has qualities of individuals on the autism spectrum. Four TD and four HFA participants completed this test, with the TD group averaging a score of 20.00 (SD = 12.62), and the HFA group averaging a score of 25.75 (SD = 7.80). The average scores for both groups were both below 32, although the average scores of the HFA group were higher than the TD group. The AQ will be discussed in depth in the discussion section as a limitation of this study.

Procedure

Before the discussion session, participants read "A Scandal in Bohemia," and "The Red-Headed League," from Arthur Conan Doyle's *The Adventures of Sherlock Holmes*. A facilitator guided a discussion with the participants, drawing from 47 discussion questions about the stories. The questions were written by the facilitator and consisted of plot, opinion, and inference questions. Sessions were video recorded and transcribed. All variables were adjusted to utterance per hour when time potentially impacted data analysis.[2]

Once transcribed, the transcripts were analyzed for basic features of language using the child language analysis (CLAN) computer program from the Child Language Data Exchange

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[1] The connected HFA group and the unconnected TD group both occurred before the unconnected HFA group and the connected TD group discussions. The former two groups did not have the AQ, nor were they compensated. The protocol was updated for the other two discussions, adding the AQ as well as compensating individuals with ten dollars for participating.

[2] The groups were capped at 60 minutes; however, the connected HFA group and the unconnected TD groups are shorter because these groups answered all the questions before the 60-minute mark.

System (CHILDES) database (MacWhinney, 2000). This program extracts language features for analysis, including type/token ratios, mean length of utterances and turns, and lexical frequency counts of the language samples. These language features were used to create baseline comparisons of basic language skills, and all time-dependent measures were adjusted to control for time differences.

The sessions were also coded for off-topic responses, disrupted turn-taking, discourse marker usage, and mental state word usage. All measures were reliability coded by two independent coders, and a third coder resolved all disagreements. The basic language measures were not reliability coded because the computer program CLAN calculated all measures. However, the transcripts were reliability checked by a second coder and finalized for use in all coding.

Basic language measures

To measure the participants' language abilities overall, MLU, utterances per turn, and type/token ratios were calculated. MLU is a basic measure of language ability, and it is the average amount of words per utterance. Utterances per turn measures discourse interactivity, as it is the number of sentences or phrases the speaker uses before finishing his turn. A low number of utterances per turn indicates high interactivity, as the speaker only uses one or two sentences before someone else takes the turn. A high number of utterances per turn is indicative of low interactivity, as the speaker says many sentences before the next speaker talks. Type/token ratios were calculated to measure the amount of language diversity between the groups. This ratio is calculated by dividing the number of different words used by the number of total words spoken. Thus, the closer the ratio is to one, the more diverse the language sample.

The language quantity of each participant was also calculated. Each participant's utterances per hour were calculated and later compared to see if the differences in language output could be attributed to one group talking more than another.

Coding

Off-topic responses. Off-topic, or non-contingent speech was assessed by categorizing participants' responses to discussion questions as either appropriate or inappropriate to the topic. An appropriate response was a sentence pertaining to the topic being discussed. If the participant's sentence answered the facilitator's question, or contained relevant information to the aspect of the story in the question, then the response was coded as appropriate. Example 6 shows the participant's appropriate answer, as TD4-Unconnected described character traits about Sherlock Holmes when asked about the story. An inappropriate response was a sentence that was off-topic, and irrelevant to the facilitator's question and not pertaining to the story. In example 7, the participant answers the facilitator's question about "A Scandal in Bohemia" by making an irrelevant comment about one character's ethnic background. Because this does not relate to the facilitator's question, this response was coded as inappropriate. Incomplete utterances and utterances that did not contribute to the topic (such as saying "yeah" and "what") were eliminated. These eliminations comprised 27.72% of the items coded, and the remaining data were analyzed.

(6) Facilitator: Why does the king come to Holmes?

TD4-Unconnected: Because Sherlock Holmes is the best at being a detective and finding things that people need.

(7) Facilitator: What is the scandal referred to in the title?

HFA4-Connected: (…) I was actually wondering if she was Jewish or not.

Disrupted turn-taking. The disrupted turn-taking analysis assessed interruptions and competition events in the conversations. An interruption event (denoted as /interrupt/) occurred when one speaker began to talk and was interrupted by another, as in example 8. In interruptions, the disruptive speaker created an opening to take over the turn by speaking in the middle of the initial speaker's turn. A competition event (denoted as /competition/) occurred when two speakers began talking at the same time, as in example 9. Competitions occurred when two speakers competed to determine who would take the turn. Thus interruptions occurred when a speaker was attempting to create an opening for himself in the conversation, while a competition occurred when two speakers occupied the turn and compete for who will speak next. The number of interruptions, competitions, and total disrupted turn-taking events were counted for both HFA and TD groups.

(8) HFA4-Connected 1: In the end we find out she had different plans, but, yes /interrupt/.

HFA3-Connected: Le - let's do this in order, please.

(9) HFA4-Connected: Yeah, no, Madison /competition/.

HFA2-Connected: Madison, yeah /competition/.

Each disrupted turn-taking event was coded for how the disrupting speaker's interruption or competition functioned. Two broad categories, supportive and non-supportive were created, each containing sub-categories.

The supportive category contained events that were used to *affirm* and *elaborate* on the initial speaker's point, building the conversation. *Affirming* events occurred when the second speaker disrupted to say a word or short phrase to indicate that he agreed with the first speaker's point. In this category the second speaker often disrupted to say "yeah" or "ok" in agreement. Example 10 illustrates an *affirming* interruption. The group discussed Sherlock Holmes'

character traits and behavior when TD4-Unconnected mentioned that he was surprised by the mention of cocaine in the story. TD4-Unconnected does not finish his sentence, however, before TD3-Unconnected interrupts him. TD3-Unconnected says "yeah", agreeing with TD4-Unconnected, so this is an *affirming* interruption.

(10) TD4-Unconnected: It was a little surprising when they were talking about, like, him using cocaine, at the beginning of the story /interrupt/

TD3-Unconnected: Yeah.

An *elaborative* event went beyond simple agreement, for example, when a participant disrupted to build on the first speaker's sentence. Often times the second speaker spoke to finish the sentence or complete the thought of the initial speaker. In example 11, the facilitator is talking about the story "A Scandal in Bohemia", and mentions that the Scandinavian royal family is very pure. HFA3-Connected, who adds that the royal family is also elitist, interrupts her. This builds on the facilitator's description of the royal family, and was coded as an *elaborative* interruption.

(11) Facilitator: [The family was] pure, like really pure and really innocent or something, kind of like that /interrupt/

HFA3-Connected: Kind of elitist.

The final category of supportive events was *similar* events, which occurred exclusively in competitions. This occurred when two speakers talk at the same time and say qualitatively the same thing. Often participants both agree "yeah" to a previous statement. Example 12 shows the facilitator asking a question, and two participants saying the same thing in a competition.

(12) Facilitator: Which president's wife?

HFA1-Connected: Madison.

HFA4-Connected: Yeah, no, Madison /competition/

HFA2-Connected: Madison, yeah /competition/

The non-supportive category included disrupted turn-taking events in which the person disrupting contradicted the first speaker (*contradictory* event), shifted the topic away from the first speaker's topic (*shifting* event), or said something completely unrelated (*unrelated* event). *Contradictory* events occurred when the second speaker disrupted solely to contradict the first speaker. In example 13, the group members are discussing Sherlock Holmes' ability to solve cases so quickly. HFA3-Connected remarks that it is "deus ex machina", or that he believes Sherlock Holmes' ability is almost divine. However, before he is able to complete that thought, HFA2-Connected interrupts to contradict HFA3-Connected, saying that because Sherlock explains how he solves the cases, Holmes is not necessarily god-like. Here HFA2-Connected speaks directly to HFA3-Connected, contradicting him.

(13) HFA3-Connected: I - it's a little bit, uh, deus ex machina, in that /interrupt/

HFA2-Connected: Except that he explains it.

Another non-supportive event was *shifting*, in which the event was used to shift the conversation to a new but related point. This was non-supportive because the topic was taken from the initial speaker. In example 14, TD8-Connected is discussing "A Scandal in Bohemia", detailing Sherlock's plan to obtain a stolen photograph. TD8-Connected begins the topic saying that he guessed Sherlock was going to have an elaborate plan. TD7-Connected interrupts to shift the topic to talking about the minute details of the plan, namely the smoke bomb. Here TD7-Connected is interrupting to shift the conversation away from the initial speaker's topic and instead introduce his own topic with regard to the story.

(14) TD8-Connected: Where it's like, yeah we're gonna like pull some elaborate ruse and like have them show us where it is /interruption/

TD7-Connected: I guessed what the smoke bomb would be used for.

The last non-supportive instance was *unrelated* events, in which the second speaker disrupts to say something unrelated to the topic. In example 15, the facilitator is telling the group that they are answering the discussion questions well, but HFA2-Connected interrupts to try to change the discussion to a previously discussed topic about the Sherlock Holmes anthology. In this example, HFA2-Connected's interruption is unrelated to the topic.

(15) Facilitator: Ok, it might be, yeah, keep up the goo(d) /interrupt/

HFA2-Connected: The one where, it's the one where Sherlock Holmes dies.

The outcome of the disrupted turn-taking event was determined by examining the transcript line directly following the interruption or competition event. It was coded for which participant successfully gained control of the conversation and which participant's topic was continued. In example 16, HFA3-Connected wins the turn, because he is the person who speaks after the event; however, by acknowledging HFA2-Connected with the phrase, "well yes," and expanding on HFA2-Connected's point, HFA2-Connected's topic wins. Turn winner had three main categories: Speaker A (initial speaker), Speaker B (disrupting speaker), or Speaker C (third party) could win the turn. Topic winner also had three main categories: Topic A (initial speaker's topic), Topic B (disrupting speaker's topic), or Topic C (new topic) could be continued at the outcome of the turn-taking event. In competitions that function as *similar*, the same topic could be carried, resulting in a score of AB, acknowledging that Speaker A and Speaker B have the same topic. However, this instance rarely occurred.

(16) HFA3-Connected: I - it's a little bit, uh, deus ex machina, in that /interrupt/

HFA2-Connected: Except that he explains it.

HFA3-Connected: Bu(t), well, yes, but he always … knows a l(ot) so much about people.

In some cases, competitions were embedded in interruptions. This would involve two people interrupting or two people winning the turn. When these complex events occurred, they were taken out of the analysis. These events comprised only 6.6% of the total disrupted turn-taking events. Additionally, events that could not be coded because the sentence was incomplete were removed. These events comprised 3.0% of all disrupted turn-taking events. Lastly, analyses were comprised of only the participants' interactions, so events in which the facilitator was Speaker B (disrupting speaker) were removed from analyses, as well as all facilitator topic winning events, as these mainly consisted of the facilitator asking another discussion question to the group. These specific facilitator events comprised 36.49% of all disrupted turn-taking events. Facilitator interactions were not analyzed in this study.

Discourse markers. Words *like* and *you know* were coded as discourse uses or non-discourse uses (for example, as a main verb). *Like* was chosen because of its prevalence in typical conversation as a discourse marker, as well as its possible uses as indicating thoughts and emotions during conversation (Fox & Robles, 2010). *You know* was chosen because it has a social use in maintaining listener understanding in conversation (Fox Tree, 2010). These words were considered to be discourse markers if they could be removed from the sentence with no loss of semantic and grammatical meaning to the sentence. For example in sentence 17, the first instance of *like* would be coded as non-discourse, as its removal from the sentence results in an incomplete sentence; moreover, *like* is part of the verb phrase "feel like". However the second

like would be coded as a discourse use, as it can be removed and the sentence and still makes sense semantically and grammatically.

(17) TD1-Connected: I feel *like* he was kind of in the game to *like* see if he could get caught.

Like was also counted as discourse for its quotative use, in which the speaker uses *like* to introduce a quote. In example 18, TD6-Connected uses *like* to introduce a quote that he paraphrases from the story. In this use he takes on the perspective of a character in the story, as evidenced by his use of "we" in the quote.

(18) TD6-Connected: I thought it was really weird like when they were just *like,* "Oh, and she doesn't keep it in her dress we checked her multiple times."

Similarly, the instance of *you know* in example 19 would be coded as a discourse use. In this instance, *you know* is not being used as a subject and verb with an object, but instead it can be removed from the sentence and the sentence makes grammatical sense. *You know* would be used in a non-discourse way if the speaker says *you know* as the subject and verb of the sentence, as in example 20.

(19) TD2-Unconnected: It's not, uh, *you know*, uh, knocking over a jewelry store.

(20) HFA1-Connected: How do *you know* that?

All direct repetitions and disfluencies were discarded from analyses. In addition, all *like* and *you knows* in sentence fragments and at the end of an incomplete sentence were removed from the analyses. The discarded data comprised 10.21% of the total discourse markers coded.

Mental state words. To indirectly measure theory of mind, the number of words referencing mental states used by each participant was also calculated. Words were counted as mental state words if the word referenced a mental or emotional state of a character in the story, the speaker's own state, or another speaker's state. This inclusion of analyzing mental state

words follows the paradigm used by Dodd, Ocampo, and Kennedy (2011), where they rated mental state words used by study participants into five categories: desire, perception, emotion behavior, emotion, and cognition. These categories were used to find mental state word usage in this study, though analyses used the total number of mental state words, and did not analyze differences between the categories of mental state words. Table 2 shows examples of the mental state words in each category. Coder 1 and Coder 2 independently coded for mental state words by compiling all words referencing a mental state from the list of all total words spoken by the groups. Agreement was calculated and disagreements were resolved by discussion to generate a final list of mental state words to be analyzed for each participant.

Table 2
Mental State Word Categories and Examples

	Desire	Perception	Emotion behavior	Emotion	Cognition
Example	Need	Aware	Chiding	Indignant	Believe
	Threaten	Feel	Cry	Angry	Decide
	Want	Listen	Yelled	Depressed	Guess
	Wish	Notice	Laugh	Exhausted	Remember
		See	Scream	Lonely	Think

Reliability

Two independent coders analyzed these pragmatic language elements. First the transcripts were reliability coded and finalized, and then each coder analyzed the transcripts for pragmatic language. Coders were trained using a handbook of the coding categories and trained on hypothetical examples of conversation. Off-topic responses, the type of disrupted turn-taking,

outcome of disrupted turn-taking (turn and topic winners), and discourse marker usage were all reliability coded. A third coder resolved disagreements.

To assess the percent agreement between coders, Cohen's Kappa (*K*) was calculated separately for all four discussion groups assessing agreement on coding discourse marker *like*, discourse marker *you know*, off-topic responses, turn-taking events, category of turn-taking events, turn winner, and topic winner. Agreement on all coding categories ranged from K = 0.642 to K = 1.00 (M = 0.835).[3] All scores ranged from good to very good agreement, as Cohen's Kappa scores of K =0.61 to K =0.80 are "good agreement" and Cohen's Kappa scores from K = 0.81 to K =1.00 are "very good agreement" (Altman, 1991). Table 3 displays all Cohen's Kappa statistics for each coding category. All disagreements were given to a trained Coder 3 to make final decisions. These final codes were then used in data analysis. The reliability for mental state words was K = 0.847, or very good agreement in picking out mental state words from the list of total words used by all participants. These disagreements were solved by discussion in order to generate a final list of mental state words to be used in analyses.

[3] Two Cohen's Kappas were unable to be calculated: for the socially unconnected TD Discourse *You Know* category, both coders only coded events as "discourse", so there were no instances of the "non-discourse" codes, so the calculation could not be performed. So although there was perfect agreement, because there were no instances of the "non-discourse" category, it could not be mathematically calculated. The other instance was for the socially connected TD Discourse *You Know* category, in which one coder had all "discourse" codes; thus all her codes were constant, and the Kappa was calculated as 0, although there were 62 agreements and only 1 disagreement between the two coders.

Table 3
Cohen's Kappa Reliability: All Coding Categories

	HFA		TD	
	Connected	Unconnected	Unconnected	Connected
Discourse Markers				
Like	0.642	0.868	0.777	0.942
You Know	1.000	0.760	--	--
Topic				
Off Topic responses	0.751	0.864	0.830	0.858
Turn-taking events				
Interruptions and Competitions	1.00	0.956	1.00	0.989
Function	0.828	0.871	0.839	0.888
Turn Winner	0.923	0.951	0.949	0.965
Topic Winner	0.820	0.760	0.807	0.809

Results

The language ability measures, frequency of off-topic speech, the number of disrupted turn-taking events, amount of discourse marker usage, and frequency of mental state word usage were analyzed for differences between the HFA group and the TD group as well as differences between the social connectedness of the groups. For each analysis, the independent variables were Group: HFA or TD, and Social connectedness: connected or unconnected.

Subject characteristics

To see if age differed between the groups, a 2 (Group: HFA, TD) x 2 (Social connectedness: connected, unconnected) ANOVA was conducted. There was a main effect for Group F (1,12) = 37.739, $p < 0.001$, and Social connectedness F (1,12) = 14.653, $p = 0.002$, with the HFA group significantly older (M = 27.01 years old, SD = 5.31) than the TD group (M = 20.08 years old, SD = 1.23). There was also an interaction of Group and Social Connectedness F (1,12) = 14.223, $p = 0.003$. Age was significantly different because the socially unconnected HFA group was about ten years older than the other groups, with a mean age of 31.30 years (SD = 2.80). The other groups had average ages of 22.72 years (SD = 3.01) for the socially connected HFA group, 20.04 years (SD = 0.47) for the socially connected TD group, and 20.11 years (SD =

1.82) for the socially unconnected TD group (Table 1). This finding will be further discussed as a limitation of this study.

The connected TD group and the unconnected HFA group were given the AQ, and the groups were compared using ANOVA. There was no effect of Group on AQ scores ($p = 0.468$), although the unconnected HFA group did have higher mean scores ($M = 25.75$, SD = 7.80) than the connected TD group ($M = 20.00$, SD = 12.62). Although this test did not differentiate the groups, the unconnected HFA group self-identified as having HFA and the connected TD group self identified as not having an autism diagnosis. This finding will be discussed further as a limitation of this study.

Basic language abilities

To assess overall basic language abilities, MLU, utterances per turn, and type/token ratios were compared using separate 2 (Group: HFA, TD) x 2 (Social connectedness: connected, unconnected) ANOVAs. There was no significant effect of Group for MLU ($p = 0.151$), utterances per turn ($p = 0.347$), and type/token ratios ($p = 0.193$). There was also no significant effect for Social connectedness for MLU ($p = 0.794$), utterances per turn ($p = 0.841$), and type/token ratios ($p = 0.724$). There was also no Group by Social connectedness interaction for MLU ($p = 0.505$), and type/token ratio ($p = 0.059$), but there was an interaction effect for utterances per turn $F(1,12) = 18.148$, $p < 0.001$, with the TD group having more utterances per turn ($M = 1.17$, SD = 0.13) than the HFA group ($M = 1.12$, SD = 0.13). Thus the groups have comparable basic language abilities and language diversity; however, the interaction of Group and Social connectedness for utterances per turn reveals a difference in how interactive the groups were, suggesting that certain groups had less interactivity. The unconnected TD group and the connected HFA group both had high utterances per turn, suggesting these groups allowed

participants to speak longer before the turn would switch to another member. The connected TD and unconnected HFA groups both had lower rates of utterances per turn, suggesting participants spoke less in a single turn before the turn would switch; these two groups were facilitated by the same individual, so these differences may be explained as a facilitator effect rather than an inherent difference between the groups. This will be further discussed as a limitation of this study.

The language quantity was also compared between the groups using total utterances. Because the groups differed in the amount of time the sessions took, total utterances for each individual were adjusted for time. Utterances were divided by the proportion of an hour each session took; thus utterances were converted to utterances per hour. For example, all utterance counts for the unconnected TD group were divided by a proportion: the length of the session, 29.08 minutes, divided by 60 minutes. This ensured that differences in the session times would not impact the data analysis. Using 2-way ANOVA (Group: HFA, TD) x 2 (Social connectedness: connected, unconnected), we found there was no main effect for Group (p = 0.859) or Social connectedness (p = 0.496) and there was no Group by Social connectedness interaction (p = 0.244). The groups have comparable amounts of total speech utterances, meaning that adjusted for the length of the sessions, the groups had similar numbers of utterances.

These language measures indicate that overall language ability was not affected by Group (HFA, TD) or Social connectedness (connected, unconnected), and subsequent comparisons of pragmatic language are not likely due to differences in total language output. For later discourse analyses, pragmatic language usage per utterance per hour was calculated. Table 4 shows the averages of these language measures between groups.

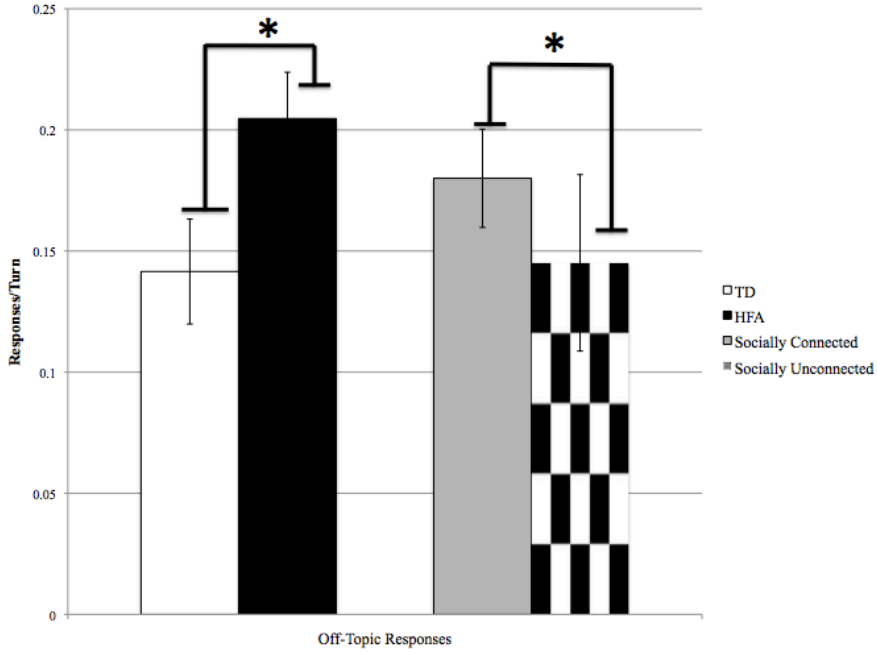
Table 4
Average Basic Language Features of Groups

Group	MLU Mean (SD)	Utterances/Turn Mean (SD)	Type/Token Ratio Mean (SD)	Utterances Mean (SD)
HFA				
Connected	8.25 (2.29)	1.23 (.109)	0.387 (0.142)	168.64 (107.1)
Unconnected	9.55 (2.12)	1.03 (.034)	0.306 (0.095)	191.91 (115.36)
TD				
Connected	11.28 (4.38)	1.08 (.054)	0.224 (.059)	231.22 (61.86)
Unconnected	10.70 (.799)	1.26 (.122)	0.339 (.051)	145.44 (55.50)

Off-Topic responses

To assess off-topic responses, the number of off-topic responses per number of turns was compared between groups using 2-way ANOVA (Group: HFA, TD) x 2 (Social connectedness: connected, unconnected). There was a main effect for Group with the HFA group having more off-topic responses/turn ($M = 0.204$, SD = 0.05) than the TD group ($M = 0.078$, SD = 0.06) $F(1,12) = 31.09$, $p < .001$. There was also an effect for Social connectedness, with the connected group more often off-topic ($M = 0.17$, SD = 0.06) than the unconnected group ($M = 0.11$, SD = 0.10) $F(1,12) = 6.455$, $p = 0.026$. There was no Group by Social connectedness interaction ($p = 0.060$). Figure 1 shows off-topic responses for all the groups. Thus, the HFA group was more often off-topic than the TD group, and socially connected groups were also more often off-topic.

Figure 1
Average of Off-Topic Responses per Turn



Disrupted Turn-Taking

Disrupted turn-taking events were analyzed for the number of total events in each group, the number of competitions and interruptions in each group, and the function of each turn-taking event. The outcome of the disrupted turn-taking events was also analyzed for the turn and topic winners for each event. These differences were all analyzed using separate Chi-Square analyses.

A chi-square analysis was first used to determine if there was a difference in the total number of disrupted turn-taking events between the four group sessions: connected HFA, unconnected HFA, connected TD, and unconnected TD. The total number of events significantly differed between the groups, X^2 (1) = 112.98, $p < 0.001$, with the socially connected TD group (294.69 total events per hour) and the socially unconnected HFA group (224.19 total events per hour) with the most disrupted turn-taking events, while the socially connected HFA group (140.38 total events per hour) and the socially unconnected TD group (88.72 total events per

hour) had the least. Because all the groups differed significantly in the amount of total events, the groups were then analyzed further to discover if the type of event (i.e., interruption event or competition event) differed between the HFA and TD groups and if the type of event differed between the connected and unconnected groups.

Separate chi-square analyses were used to compare the number of interruption and competition events for both the HFA and TD groups and the social connectedness of the groups. Interruptions were defined as disrupted turn-taking events in which a second speaker interrupts an initial speaker during his turn. Competitions were defined as disrupted turn-taking events in which two speakers would begin speaking simultaneously in an attempt to control the conversation. There were no significant differences between the HFA and TD groups in the amount of interruptions and competitions occurring over the course of the session ($p = 0.46$). The HFA group used interruptions 86.90% of all disrupted turn-taking events, and the TD group used interruptions 85.01% of all disrupted turn-taking events. Competitions comprised 13.10% of HFA disrupted turn-taking events, and 14.99% of TD disrupted turn-taking events. Thus the composition of disrupted turn-taking events was similar between the groups, with more interruptions occurring throughout the course of conversation than competitions.

Another chi-square analysis also revealed no significant difference between the connected and unconnected groups ($p = 0.26$), and the distributions of these events were very similar to the HFA and TD groups. Interruptions comprised 84.77% of the disrupted turn-taking events in connected conversations, and 87.65% of disrupted turn-taking events in unconnected conversations. Competitions comprised 15.23% of connected disrupted turn-taking events, and 12.35% of unconnected events. Thus, although the first analysis showed differences in the amount of total events, the type of turn-taking event does not differ between the HFA and TD

groups, nor does it differ between the connected and unconnected groups. Because of this, the interruption and competition events were collapsed, and all further analyses consist of the total disrupted turn-taking events, and interruptions and competitions were not analyzed separately. Table 5 shows the number of interruptions and competitions per hour as well as the percentage of interruptions and competitions out of all disrupted turn-taking events for the HFA and TD groups and the socially connected and unconnected groups.

Table 5

Disrupted Turn-Taking Types and Functions across Groups

	Number of Disrupted Turn-Taking Events Per Hour		Function of Disrupted Turn-Taking Events Per Hour	
	Total Interruptions (% of events)	Total Competitions (% of events)	Total Supportive Events (% of events)	Total Non-supportive Events (% of events)
Group				
HFA	316.81 (86.90%)	47.76 (13.10%)	157.00 (43.06%)	207.57 (56.94%)
TD	325.94 (85.01%)	57.47 (14.99%)	169.77 (44.28%)	213.63 (55.72%)
Social Connectedness				
Connected	370.64 (84.77%)	66.58 (15.23%)	153.48 (37.25%)	258.56 (62.75%)
Unconnected	274.25 (87.65%)	38.65 (12.35%)	173.29 (55.38%)	139.61 (44.62%)

The disrupted turn-taking events were also analyzed for how the disrupted events functioned, whether or not the interruptions and competitions served as supportive or non-supportive to the initial speaker. Separate chi-square analyses were conducted for Group (HFA and TD) and Social connectedness (connected and unconnected) to see if differences existed between these groups for supportive and non-supportive disrupted turn-taking events. The supportive category included all events that functioned to affirm, elaborate, or provide similar information. Non-supportive events included all events that functioned to shift, contradict, or provide unrelated information. Chi-square analysis revealed no difference between supportive and non-supportive events for Group ($p = 0.738$), with the HFA group having 43.06% of events

functioning as supportive, and the TD group having 44.28% function as supportive. The HFA group also had 56.94% of all events function as non-supportive, and the TD group was non-supportive in 55.72% of events. Thus, both groups were more non-supportive than supportive in disrupted turn-taking events. There was a difference in the function of interruptions for Social connectedness X^2 (1) = 23.62, $p < 0.0001$, with the connected group using disrupted turn-taking events to be supportive in 37.25% of events, while the unconnected group was supportive in 55.38% of events. The connected group was also more non-supportive than the connected group, having 62.85% of events function as non-supportive, while the unconnected group was non-supportive in 44.62% of all events. Table 5 shows the total number of supportive and non-supportive events for both HFA and TD groups and connected and unconnected groups as well as the percentage of supportive and non-supportive events for all disrupted turn-taking events. Thus the function of disrupted turn-taking events does not appear to differ between HFA and TD groups, but the Social connectedness of group members does appear to have an effect on the function of disrupted turn-taking events, with socially connected individuals using disrupted turn-taking to be more non-supportive than unconnected individuals.

To summarize, the total number of disrupted events differed between the groups, with the connected TD and unconnected HFA groups having the most disrupted events, and the connected HFA group and the unconnected TD group having the least amount of disrupted events. All groups used a similar number of interruptions and competitions in disrupted turn-taking, with more interruptions than competitions. The HFA and TD groups used these events similarly, using more non-supportive than supportive events. However, social connectedness had an effect on the function of the disrupted turn-taking events, as connected individuals were more non-supportive than unconnected individuals. These analyses all pertain to the nature of the disrupted

turn-taking event, analyzing the initial speaker and the person who disrupts or competes with the initial speaker for the conversational floor. The next set of analyses pertain to the outcome of the disrupted turn-taking event, specifically analyzing the turn winner and the topic winner.

The turn winner was analyzed using chi-square, in which speaker A (initial speaker), speaker B (disrupting speaker), or speaker C (third party) could win the turn as the outcome of an interruption or competition event. As with the pervious analyses, interruption and competition events were collapsed, and the total amount of disrupted turn-taking events was analyzed. Separate analyses were performed for the Group (HFA and TD) and Social connectedness (connected and unconnected). Chi-square analysis revealed no difference in the turn winner between HFA and TD groups ($p = 0.195$). Speaker A won the turn most often in both HFA (49.72% of events) and TD groups (48.62% of events). After Speaker A, Speaker C was most likely to win the turn, with 38.95% of HFA turns going to Speaker C, and 43.48% of TD turns going to Speaker C. Speaker B was least likely to win the turn, with HFA Speaker B winning the turn 11.33% of all events, and TD Speaker B winning 7.90% of all events. The patterns of turn winning after interruptions and competitions are comparable between the HFA and TD groups, following a pattern in which the initial speaker most often wins the turn back, followed by a third party, and the disrupting speaker is least likely to win the turn after a disrupted event.

There was a difference in the turn winner for the social connectedness $X^2 (2) = 6.75$, $p = 0.034$. Although both groups showed the same qualitative patterns, with Speaker A winning most, followed by Speaker C, followed by Speaker B, there were significant differences in the specific rates between the connected and unconnected groups. In connected groups, Speaker A won 46.54% of events, and unconnected groups had Speaker A winning 52.79% of events. Speaker C won 41.68% of events in connected groups, and 40.69% in unconnected groups. The largest

difference between groups was in the proportion of turns Speaker B won, with 11.78% of connected events having a Speaker B winner, but in unconnected conversations, only 6.51% of the time did Speaker B win. While the turn winner does not differ across Group, with the HFA and TD groups having comparable patterns of turn winning, there was a difference between Social connectedness, with the connected group having a much higher proportion of the disrupting speaker winning the turn. In connected group conversations, the disrupting speaker more often gains the floor, seemingly stealing turns from the initial speaker. Table 6 shows the turn winner distribution across the speakers for both HFA and TD groups and socially connected and unconnected groups.

Table 6

Disrupted Turn-Taking Turn Winner Outcome across Groups

	Turn Winner Distribution per Hour		
	Total Speaker A (% of events)	Total Speaker B (% of events)	Total Speaker C (% of events)
Group			
HFA	181.26 (49.72%)	41.32 (11.33%)	141.99 (38.95%)
TD	186.40 (48.62%)	30.30 (7.90 %)	166.70 (43.48%)
Social Connectedness			
Connected	202.49 (46.54%)	51.23 (11.78%)	181.36 (41.68%)
Unconnected	165.18 (52.79%)	20.38 (6.51%)	127.33 (40.69%)

In addition to turn winner, the topic winner was also assessed. While turn winner assessed the speaker following a disruption, topic winner assessed the trajectory of the conversation after a disruption. Thus we assessed if Topic A (initial speaker's topic), Topic B (disrupting speaker's topic), or Topic C (new topic of conversation) was carried at the outcome of a disruption. In rare cases, Speakers A and B could jointly win the topic, which occurred only in competitions when the continued topic was shared between Speaker A and Speaker B since they spoke at the same time saying qualitatively the same thing. Chi-square analysis revealed only a marginally significant difference between the HFA and TD groups for the topic winner,

X^2 (3) = 12.638, p = 0.055, in HFA groups, Topic B was continued in 56.32% of all events, and in TD groups, Topic B was continued in 45.58% of events. Topic A was next likely, in HFA groups, Topic A was continued in 30.01% of events and in TD groups, Topic A was continued in 38.97% of events. Topic C had very similar rates for both groups, in the HFA group, Topic C was continued in 12.47% of events, and in TD groups, Topic C was continued in 11.98% of events. Topic winning for Speakers A and B simultaneously occurred only in 1.21% of events in HFA conversations and in 3.47% of events in TD conversations. Thus both groups have similar rates of a new topic being continued, but in the HFA group, the disrupting speaker's topic was continued more than in the TD group. In the TD group, the initial speakers' topics were continued more than in the HFA group.

Topic winner was also analyzed for Social connectedness, and there was no significant difference between the groups in topic winners, although it also approached statistical significance, X^2 (3) = 7.528, p = 0.057. The topic winning patterns followed the patterns established in topic winning for HFA and TD conversations, with Topic B continued most of the turns, 52.77% in connected and 48.07% in unconnected disrupting turn-taking events, and Topic A was continued about a third of the time, 33.06% in connected and 36.76% in unconnected disrupted turn-taking events. Rates of Topic C continued after disrupted turn-taking events were similar to the HFA and TD groups, with the connected group's Topic C continued in 12.93% of events and the unconnected group's Topic C continued in 11.23% of events. Simultaneous Speaker A and Speaker B's topic won 1.24% of events in the connected group and 3.94% of the time in the unconnected group. Although not significant, it appears that in connected groups, the disrupting speaker's topic was continued more than it was in unconnected groups. Thus the disrupting speaker is unlikely to win the turn, but he is most likely to win the topic, especially in

HFA and Socially connected conversation. The distribution of topic winners for the groups is displayed in Table 7.

Table 7

Disrupted Turn-Taking Topic Winner Outcome across Groups

	Topic Winner Distribution per Hour			
	Topic A (% of events)	Topic B (% of events)	Topic C (% of events)	Topic AB (% of events)
Group				
HFA	109.05 (30.01%)	204.64 (56.32%)	45.30 (12.47%)	4.38 (1.21%)
TD	149.42 (38.97%)	174.74 (45.58%)	45.95 (11.98%)	13.30 (3.47%)
Social Connectedness				
Connected	143.46 (33.06%)	228.97 (52.77%)	56.09 (12.93%)	5.366 (1.24%)
Unconnected	115.02 (36.76%)	150.41 (48.07%)	35.15 (11.23%)	12.32 (3.94%)

Discourse Markers

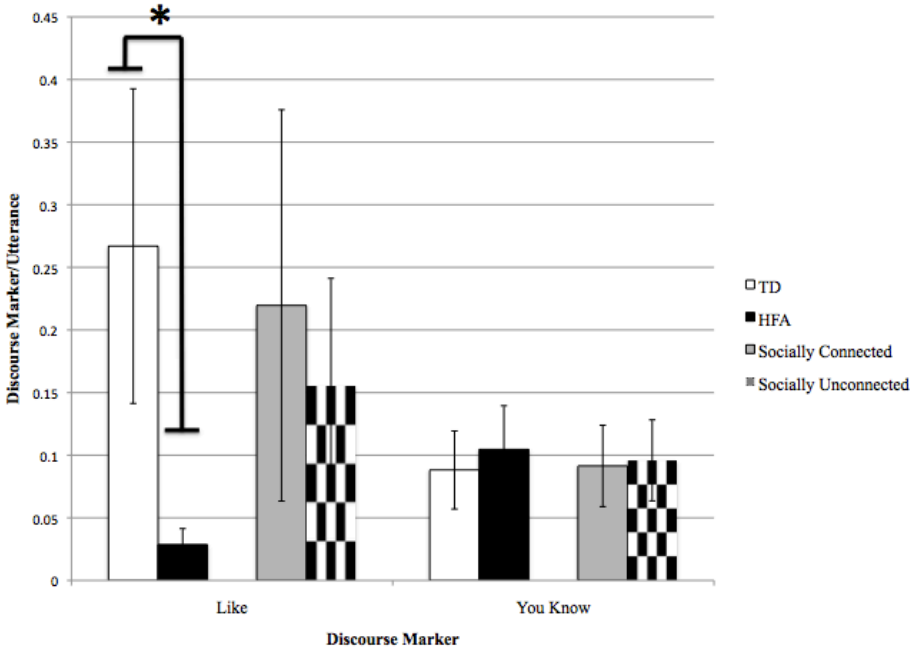
The frequency of discourse markers per utterance was analyzed and compared between the groups using 2 (Group: HFA, TD) x 2 (Social connectedness: connected, unconnected) ANOVA. There was a main effect for Group in the average amount of discourse *likes* used per utterance F (1,12) = 13.391, p = 0.003, with the TD group using more *likes* per utterance (M = 0.51, SD = 0.36) than the HFA group (M = 0.029, SD = 0.04). There was no main effect for Social connectedness (p = 0.585), and there was no Group by Social connectedness interaction (p = 0.377). Figure 2 shows the average number of *likes* per utterance between the HFA and TD groups and the socially connected and unconnected groups.

The number of discourse *you knows* was also measured for average number of discourse usages per utterance. There was no effect for Group (p = 0.345), and there was no effect for Social connectedness (p = 0.325). There was also no interaction of Group and Social connectedness (p = 0.542). Although there was not a significant difference, the HFA group used more discourse *you know* per utterance (M = 0.105, SD = 0.07) compared to the TD group (M = 0.072, SD = 0.062). Figure 2 shows the average number of discourse markers per utterance for

all groups, showing that the TD group uses more discourse *likes* when compared to the HFA group, but there was no difference in the amount of discourse *you know*.

Figure 2

Average Number of Discourse Marker Usage per Utterance



Mental state language

The frequency of mental state words per utterance was analyzed as an indirect measure of theory of mind. Using 2-way ANOVA, we found a main effect for Group, with the TD group (M = 0.67, SD = 0.17) using more mental state words per utterance than the HFA group (M = 0.37, SD = 0.12) F (1,12) = 18.704, p = 0.001. There was no main effect for Social connectedness (p = 0.206), and there was no Group by Social connectedness interaction (p = 0.227). The HFA group used less mental state words than the TD group overall.

Because there was a significant difference for Group in mental state word usage, mental state words were correlated with the amount of discourse marker *likes*/utterance, discourse marker *you know*/utterance, off-topic utterances/turn, and MLU, the measure of basic language

ability. We found that there was a positive relationship between the number of mental state words used by each participant and the number of discourse marker *likes*/utterance r (14) = 0.702, p = 0.002, as well as a significant negative correlation between the number of mental state words used and the amount of off-topic utterances/turn r (14) = -0.698, p = 0.003 and MLU r (14) = 0.555, p = 0.026. The correlation between mental state words and discourse marker *you know*/utterance was not significant r (14) = 0.248, p = 0.355. This indicates that mental state words and discourse *likes* vary together, as do larger MLUs. Also mental state words and off-topic responses were negatively correlated, meaning that when more mental state words are used, there are also less off-topic responses.

Interestingly, discourse marker *you know*/utterance did not correlate with mental state words, and this variable also did not correlate significantly with discourse marker *likes* r (14) = 0.008, p = 0.978, off-topic responses r (14) = 0.209, p = 0.437, and MLU r (14) = 0.425, p = 0.100. Thus in addition to being non-significant between the HFA and TD groups, *you know* also does not correlate with other measures of pragmatic language.

Discussion

In this study, we identified differences in pragmatic language between HFA and TD adults in a naturalistic setting by coding conversations for off-topic responses, disrupted turn-taking events, discourse marker usage, and mental state word usage. First the groups were compared on basic language measures to assess whether or not the groups were comparable in language output. All language measures were not statistically significant, except utterances per turn, in which a Group by Social connectedness interaction was significant. This suggests an experimenter effect, as the same facilitator led the unconnected HFA and connected TD groups, while different facilitators led the other two groups. The groups led by the same facilitator both

had higher rates of discourse interactivity than the other two groups as indicated by lower utterances per turn scores. This finding highlights the delicacy of conversations, as even a change in the facilitator can impact basic language features such as discourse interactivity as measured by utterances per turn. Utterances per turn were not used in any of the other data analyses, and thus did not impact the interpretation of any of the other findings. Also future replications of this work should use the same facilitator in all conversations to discover if this difference in discourse interactivity is due to the facilitator. This study did not analyze the facilitator interactions with the participants, but future work should explore the effect of different facilitators on pragmatic language. Nevertheless, the HFA group was comparable to the TD group on all other measures of basic language, reinforcing that these HFA individuals were high functioning and did possess complex language abilities similar to the TD adults.

The first pragmatic language feature analyzed was the number of off-topic responses. We found that the HFA individuals were more often off-topic than TD individuals, which suggests that individuals with HFA have difficulty staying germane to the context of the conversation, as they have much higher rates of being off-topic than TD individuals. In this study, socially connected individuals were also more often off-topic. This suggests that previous experience in social groups is important to the context of the conversation. In this case, acquaintances appeared to go off the topic more than strangers. It is possible that acquaintances are more likely to discuss common interests and make digressions while strangers are unaware of mutual interests and stay on the topic. This suggests that the HFA individuals may have difficulty understanding context in groups, as this inclination to stay off-topic is seen in conversations between HFA acquaintances and strangers alike. These findings build on previous work that has studied off-topic responses in individuals with HFA, but it goes beyond previous work by exploring the

social connectedness of the individuals. Further work should be done to discover how the social connectedness of group members impacts not only pragmatic language but other social behaviors as well.

The next aspect of pragmatic language studied was turn-taking, specifically interruptions and competitions that occur when turn-taking is disrupted. There was a difference between the groups for the amount of disrupted turn-taking events, with the unconnected HFA group and the connected TD group having more disrupted turn-taking events than the connected HFA and unconnected TD groups. This difference may be due to a facilitator effect, as the two groups with the highest amounts of disrupted events had the same facilitator. Additional work should be done to explore the effect of the facilitator on the amount of disrupted turn-taking events.

Of primary interest in this study were the complexities of turn-taking, namely what kind of turn-taking events occurred and how the events functioned in the conversation. There was no difference between the groups for interruptions and competitions; all groups used interruptions over 80% of the time. This suggests that both HFA and TD groups and connected and unconnected groups pattern similarly in the dynamics of turn taking. To further parse the complexity of turn taking, the functions of the disrupted turn-taking events were also analyzed. There was no difference between the HFA and TD groups for how often disruptors supported or did not support the initial speaker. The Social connectedness variable was significant for the function of the disrupted turn-taking event; connected groups were more likely to be non-supportive than unconnected groups. Although previous work has shown that friends and acquaintances interrupt each other more (Panalp & Benson, 1992), this study suggests that friends and acquaintances interrupt each other to serve different functions. Friends seem to be more impolite, and challenge initial speakers by being unsupportive, while strangers are more

likely to interrupt or compete in an agreeable and supportive way, ultimately portraying themselves as polite. However there was no difference between the HFA and TD groups, but this may be due to the small sample size; however, the results trend in the direction of our hypothesis, with the HFA group having more non-supportive events (56.94% of events) than the TD group (55.72% of events). Future work with larger sample sizes should explore the function of interruptions in individuals with HFA.

In addition to the function of disrupted turn-taking events, the outcome of these events was analyzed. First the turn winner was analyzed to see if differences emerged in the pattern of the conversational outcome. Results showed that the HFA and TD groups have similar patterns of turn winners after interruptions and competitions. The initial speakers and third party speakers were most likely to win turns, and disrupting speakers were least likely to win. This suggests that when interruptions occur, the disruptor typically does not win the turn, instead the initial speaker is allowed to keep going, or someone else takes advantage of the disruption and takes the turn for himself. There was a difference in Social connectedness for turn winner, in which the disrupting speaker was almost twice as likely to win the turn in conversations with socially connected individuals than socially unconnected individuals. Although these events only comprised about 11% of disrupted turn-taking events in connected groups, this is higher than the unconnected groups. This may reinforce the results of the off-topic response analysis, in which acquaintances are less polite than strangers; in this case, the disruptor is more often acknowledged and allowed to continue speaking despite disrupting a speaker in an attempt to take the conversational floor.

The topic winner was also assessed to measure the progression of the conversation after a disrupted turn-taking event. Both HFA and TD and connected and unconnected groups had marginally significant differences for topic winner. The patterns for topic winner were not the

same as the turn winner; although the initial speaker was still very likely to carry the topic, the disruptor was most likely to carry the topic, and a new topic was rarely initiated. We found a marginally significant result for topic winner distributions between the HFA and TD groups. In TD conversations, the initial speaker and the disruptor were nearly equally likely to carry on the topic; however, in HFA conversation, the disruptor was more likely to continue their topic than the initial speaker. This pattern also emerged for Social connectedness, with the disrupting speaker's topic in connected groups continued more often than it was in unconnected groups. In these cases, the disruptor was acknowledged, not by winning the turn, but by winning the topic. This may influence why the socially connected group and the HFA group were more often off-topic. Since the initial topic was less often carried, the topic shifted more frequently. Not only were disfluencies occurring during disruptions to the initial speaker's turn, but the topic was also being disrupted, as the initial speaker was unable to continue his thought, and the topic changed. However, it is important to emphasize that this effect was not significant, perhaps due to the low sample size. Future work should explore patterns of turn-taking with regard to the topic of conversations, and perhaps turn and topic winner can be predicted based on other social behaviors such as eye-gaze.

This study also looked at the use of discourse markers in conversation. The HFA group was much less likely to use the discourse marker *like* than the TD group. Although *like* has been argued to have a specific role in conversation, namely being used as a filler or indicating imprecision, *like* also has the preconception of being used more often in informal conversations (Fox Tree, 2006). Dailey-O'Cain found that people perceive others who use *like* as young, attractive, cheerful, and successful, but also as less intelligent, indicating that *like* has strong social connotations associated with its use (Dailey-O'Cain, 2000). Individuals with HFA may be

less likely to use *like* because they more often use more formal, pedantic speech, a robust finding in many studies of language and HFA (Landa, 2000). There was also no difference in Social connectedness, which suggests that in a group of peers, regardless of whether or not group members know each other, *like* is used equally often. Future work should further parse the role of *like* in conversation, perhaps looking at *like* usage in formal as well as informal peer settings. Conversations with HFA may seem more pedantic and overly formal because of the infrequency of discourse markers such as *like*.

Another possible interpretation is that because individuals with autism are impaired in theory of mind, they may be less likely to use *like*, particularly the quotative use, which conveys thought and affect (Fox & Robles, 2010). All discourse uses of *like*, not just the quotative use, have been hypothesized to strongly influence the interpretation of the conversation, building the "shared world" between conversational partners (Fox & Robles, 2010, p. 732). Thus, individuals with HFA may use less *likes* because they have a more difficult time interpreting others' perspectives in conversation as well as expressing their own internal thoughts and attitudes. However, because individuals with HFA do not use discourse *like* often does not necessarily mean that they do not successfully interpret *like* when it is used by others; in fact these individuals do use the discourse use of *like*, it is just much less frequently than typical adults. Perhaps it is their difficulties with theory of mind and understanding references to mental states that also carries over to difficulty with using discourse *like* which is important in conveying and understanding mental states. Understanding the role and function of *like* and other discourse markers is important to understanding typical communication as well as the communication skills of individuals with autism as these discourse markers play a significant role in speakers' interpretation of conversation.

Discourse marker *you know* did not have a significant effect between the groups, despite its reference to social understanding when used in conversation. When correlated with off-topic speech, mental state words, and discourse *likes*, there was no significant correlation between any of these measures with the use of *you know*, suggesting that *you know* has a different function than discourse marker *like*, particularly a non-social function. One alternative hypothesis of *you know*'s role in conversation is that it aids in fluent turn-taking. Fox Tree and Shrock (2002) state that using *you know* in the terminal position in a sentence signals the conversation to move forward. In fact, although *you know* appears to be a speaker asking for listener understanding, in Fox Tree and Schrock's study, only 12% of terminal *you knows* were followed by responses. An additional postulate for the function of *you know* is that it functions in the organization of conversation, that *you know* may signal topic shifts or areas of the topic the speaker wants to emphasize (Fox Tree, 2002). More work should be done to explain the role of *you know* in sentences. These findings demonstrate that discourse markers have varied use in conversations, some relating to social cues, and others that have additional roles in conversation. The specific role of *like* and *you know*, as well as other discourse markers, should be further examined in individuals with HFA as well as TD individuals. Future work will continue to find patterns of discourse marker usage in individuals with autism, and ultimately these patterns may have utility in diagnosing autism, particularly HFA.

Although theory of mind was not assessed directly in this study, the number of references to mental states was used as an indirect measure of theory of mind. This measure revealed that the HFA group used fewer mental state words than the TD group, a finding similar to that stated in Beaumont and Newcombe's study (2006). This measure was correlated with discourse markers and off-topic speech, and the analyses revealed that mental state words vary with the

number of discourse *likes*, suggesting that *like* may have a role in keeping others' mental states in mind. *You know* did not correlate with the mental state word usage, suggesting *you know* does not contribute to the social context of conversation. Although an indirect measure, these significant correlations suggest that pragmatic language features such as discourse markers and off-topic speech play a role in the social context of conversations. Thus parsing out these differences in pragmatic language may lead to further understanding of the differences and deficits of HFA individuals in social conversation.

There are a few important limitations of this study. First, the participant characteristics were significantly different in age; one of the HFA groups was significantly older than the other groups. Thus in interpreting these results, the age gap between these groups of participants may be driving the effects. However, the older HFA group had a mean age of 31.3 years old, and the other groups ranged from 20.11 to 22.74 years old. There are no critical periods, or significant developmental changes that occur, particularly in language, across this age range, so it is unlikely that age was the factor driving these results. However it is possible that more experience in social situations may lead to better understanding and usage of pragmatic language features. Future work should correct this limitation and control the participants for age. Furthermore, future work should examine children and adolescents' use of pragmatic language elements to see when developmental changes take place relative to TD children and adolescents, particularly seeing if experience with age can facilitate and aid the use of pragmatic language skills.

Another important caveat is the use of the AQ. Half of the group did not even fill out the AQ, and no formal diagnostic test was performed to confirm diagnosis. However, the HFA individuals were members of a group specifically for individuals with HFA, and self identified as having HFA. The TD individuals also did not identify as having HFA. In future replications of

this study, diagnosis should be formally confirmed, as well as other factors that may influence language, such as IQ.

The AQ also did not have utility in splitting the groups into HFA and TD groups; the average of the HFA group scores were below the autism cutoff, although above the mean of the TD group. One TD individual scored above the autism cutoff, and three HFA individuals scored below the autism cut-off. This test is not meant to diagnose individuals, rather it is meant to be a screening test for individuals suspected of having autism. When it was developed, engineers and mathematically oriented individuals scored higher on the AQ, demonstrating that even without a formal diagnosis, individuals may exhibit some traits of those on the autism spectrum (Baron-Cohen et al., 1999). Although the AQ scores do not support the HFA and TD group designations, this test was not a diagnostic test, and furthermore, the differences in pragmatic language found between the groups, despite the small sample size, supports that the HFA and TD groups are separate.

In addition to formal diagnosis, future replications should exhibit more experimental control in the discussion sessions. Because the sessions varied slightly in length, many of the language measures had to be controlled for time. Also the same facilitator should be used in all discussion sessions. As evidenced by a significant utterance per turn measure, the facilitator can have an effect on the course of the conversation. This also may have affected the amount of disrupted turn-taking events. This demonstrates the complexity of conversation, especially in a naturalistic setting. Facilitator interactions were not analyzed, but these interactions may play a role in pragmatic language output, and these interactions should be explored further. Despite the differences in facilitator, significant effects were still found for discourse markers, off-topic responses, disrupted turn-taking events, and mental state words.

Researchers should continue to explore differences in pragmatic language usage in individuals with HFA, particularly in a naturalistic setting. Although this study had a low sample size, by looking specifically at all participants' sentences, a large volume of data was generated, and patterns emerged that distinguished the HFA and TD groups. Pragmatic language should also be correlated to formal theory of mind assessments to ascertain the extent that pragmatic language relates to theory of mind, as this study suggests that the two are strongly linked. Perhaps pragmatic language also relates to other social behaviors such as eye-gaze. Future work should attempt to compare these findings to lower-functioning individuals with autism.

This study is one of the first to look at quantitative differences in pragmatic language in individuals with HFA, and future work will continue to explore and further define the pragmatic abilities of adults with HFA. Although it may be difficult to change pragmatic language usage with interventions and therapies, perhaps learning about these differences can lead to diagnostic tests, particularly for those with HFA, who are very functional but have very specific deficits. By identifying these individuals using pragmatic language, they may be able to get the resources they need to lead successful lives.

This study is unique in that pragmatic language was studied in a naturalistic setting and conversations were coded quantitatively for specific features of pragmatic language. The results indicated that there were many differences in pragmatic language, especially in the use of discourse marker *likes* and off-topic responses. The social connectedness of the individuals was also unique to this paradigm, and many of the effects suggest that pragmatic language elements can be mediated by the social connectedness and experience of group members. There is much work that needs to be done to discover the exact usages and correlates of pragmatic language, but this study suggests that pragmatic features can be quantitatively assessed, and that the naturalistic

setting is important in understanding pragmatic langue usage in individuals with HFA as well as TD adults.

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